II. "On the Percentage of Argon in atmospheric and in respired Air." By ALEXANDER KELLAS, B.Sc., Assistant in the Chemical Department of University College, London. Communicated by Professor RAMSAY, F.R.S. Received November 14, 1895.

Although blood invariably contains a small amount of dissolved nitrogen, it appears that with animals no absorption of that gas takes place save what is due to its solubility in the serum of the blood. Nor is nitrogen eliminated from the system in the elementary state.

At Professor Ramsay's suggestion, experiments have been made on the comparative amount of argon in ordinary air, and in air which had been frequently breathed, with the view of ascertaining whether, if the proportion of oxygen and carbon dioxide in air be very much altered, argon would either enter into, or be expelled from, the respiratory system. The result of the experiments to be described is to show that the proportion of argon to nitrogen remains nearly normal, even when the air has been greatly altered in composition by respiration.

1. *Percentage of Argon in Atmospheric Air.*—A mercury reservoir, the capacity of which was accurately determined by weighing with water, held 555·2 c.c. The upper end was fitted with a three-way tap, sealed on to the glass. Through this tap was admitted air, purified by passage over soda-lime and phosphoric anhydride, to remove water-vapour and carbonic anhydride. This reservoir was jacketed with water of known temperature, so that the volume of the air could be measured with great exactness. The other branch of the three-way tap led to a tube filled with copper, in order to absorb oxygen; one containing copper oxide to destroy any organic matter which might have been present, and one filled with magnesium turnings to absorb nitrogen; these tubes were kept red-hot. Other tubes were filled with soda-lime and phosphoric anhydride, so as to remove water and carbon dioxide, which might have been produced. The air was circulated over these absorbents until little but argon was left. The gas-holder was filled three times at 18·8° C., and 752·1 mm. pressure. After absorption had nearly ceased, the remaining gas was pumped out of the tubes, mixed with oxygen, and sparked for many hours in presence of caustic soda, to remove the last traces of nitrogen. The residue, after absorption of oxygen with potassium pyrogallate, measured 15·91 c.c. at 21·4° C., and 754·5 mm. pressure.

Reducing both volumes to standard temperature and pressure, it appears that

1542·0 c.c. of air yielded 14·45 c.c. of argon, or
100·0 c.c. of air contain 0·937 c.c. of argon.

Calculating the percentage in atmospheric nitrogen, we have:—

100 c.c. of mixed atmospheric nitrogen and argon contain 1·186 c.c.

Owing to the avoidance of the presence of water during these experiments, they are probably more accurate than the original experiments of Lord Rayleigh and Professor Ramsay. They found* 1·04 and 1·03 in two experiments in which the nitrogen was removed by sparking with oxygen in presence of dilute caustic soda; and 1·11 when the nitrogen was removed by means of magnesium.

Owing to the vacation, it has not been possible to put this result on record before now. And M. Th. Schloesing, *fils*, has recently published† the results of a series of estimations in which the percentage of argon in atmospheric nitrogen was found to be 1·180 to 1·185, or as a mean 1·183 per cent., a number almost identical with that just recorded. M. Schloesing has re-calculated the ratio which ought to subsist between the densities of atmospheric and "chemical" nitrogen on the basis of his determinations; but in doing so, he has made use of the value 1·2505 gram as the weight of 1 litre of the latter, instead of 1·2511.‡ Moreover, he has assumed Regnault's value, now superseded, for the weight of 1 litre of hydrogen, viz., 0·0896 gram, instead of that given by the more recent determinations, 0·0899.§ These are not serious errors, but it is more satisfactory to calculate the correct number. The question is:—If the weight of a litre of pure nitrogen is 1·2511 gram, and of argon 1·7818 gram, and if atmospheric nitrogen contain 1·185 per cent. of argon, what should be the weight of a litre of the latter? The answer is 1·2574. Lord Rayleigh found the number 1·2572, one almost exactly identical.

For material for the second part of this research, I have to express my thanks to Dr. Marcet, F.R.S., and his assistant, Mr. Floris. The air was analysed before having been breathed, and had the normal composition:—

Nitrogen and argon	79·02 per cent.
Oxygen	20·93 „
Carbon dioxide	0·05 „
	100·00

* "Argon," 'Phil. Trans.,' 1895, A, p. 221 and 214.
† 'Comptes Rendus,' vol. 121, p. 605.
‡ 'Phil. Trans.,' 1895, A, p. 189.
§ *Ibid.*, p. 202.

The air was breathed over and over again by Mr. Floris, until after 10 minutes' respiration its composition had become :—

Nitrogen and argon	80·96	per cent.
Oxygen	5·40	,,
Carbon dioxide	13·64	,,
	100·00	,,

An estimation of the argon was carried out in precisely the same manner as before, on 1297·8 c.c. of breathed air, measured at 17·2° C. and 759 mm. pressure. But the air was breathed over water, the requisite change of volume on respiration having been secured by breathing into one of Dr. Marcet's counterpoised gas-holders. The argon found measured at 17·7° C. and 752·3 mm. pressure, 12·85 c.c. These numbers corrected give :—

1196 c.c. of breathed air yielded 11·72 c.c. of argon.
100 c.c. ,, ,, 0·980 c.c. of argon.

Calculating the percentage on the nitrogen, we have :—

100 c.c. of nitrogen and argon of breathed air contains 1·210 c.c.

This percentage is larger than that in normal air. One of two suppositions may be made : either the increased amount is due to the air having been confined over water during breathing, or argon is given off from blood in greater amount than it is absorbed, when the composition of the air in the lungs is so much altered ; the former appears the more probable supposition. In any case the difference is not great ; and it would appear that argon, like free nitrogen, plays no important part in the animal economy, save as a diluent.

III. "Examination of Gases from certain Mineral Waters." By Alexander Kellas, B.Sc., and William Ramsay, Ph.D., F.R.S. Received November 14, 1895.

A sample of gas of an inflammable nature, sent to Mr. Crookes by Mr. C. Lothian Bell, of Middlesbrough, from "Allhusen's Well," was sent on to us to be tested for argon. The usual constituents, nitrogen, hydrocarbons, &c., were removed by the usual absorbents, magnesium, copper oxide, &c., and finally by sparking with oxygen over caustic soda. The only noticeable feature was the great difficulty in removing the hydrocarbon, which for long resisted the action of red-hot copper oxide. The circulation had to be continued for two days before absorption was nearly complete. In one case (Kellas) 555 c.c. of gas gave 2 c.c. of residue, and in another (Ramsay)